BULLETIN No. 31.

174

U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS.

DIETARY STUDIES

AT THE

UNIVERSITY OF MISSOURI

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H. B. GIBSON, S. CALVERT, and D. W. MAY,

UNIVERSITY OF MISSOURI.

WITH COMMENTS.

BY

W. O. ATWATER and CHAS. D. WOODS.

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WASHINGTON:
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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE, OFFICE OF EXPERIMENT STATIONS, Washington, D. C., June 15, 1896.

Sir: I have the honor to transmit herewith a report on the food supply and consumption in Missouri, made in 1895, by H. B. Gibson, professor of chemistry of the University of Missouri, S. Calvert, and D. W. May. Two dietary studies of a students' club at the University of Missouri and an investigation of the relative bread and meat consumption in families in the State are included in this report. These investigations constitute a part of the inquiries made with aid of the funds appropriated by Congress "to enable the Secretary of Agriculture to investigate and report upon the nutritive value of the various articles and commodities used for human food." They were conducted under the immediate supervision of Prof. W. O. Atwater, special agent in charge of nutrition investigations, in accordance with instructions given by the Director of this Office.

In carrying out the provisions of the act above cited, representative localities have been selected in different parts of the country in order that definite information regarding the food supply and consumption of people living under different conditions might be obtained. The University of Missouri, at Columbia, Mo., offered many facilities for dietary work. It has well-equipped laboratories, and the department of chemistry was under the direction of Professor Gibson, one of the best authorities on dietary work in America. It was the original intention to make a somewhat extended series of investigations, but the work which was begun by Professor Gibson was interrupted by his untimely death in October, 1895. Comments on these investigations made by Professor Atwater and Mr. Woods, and appended to Professor Gibson's report herewith, indicate the value of the Missouri dietary investigations when taken in connection with those carried on elsewhere.

Professor Gibson's report and the accompanying comments by the special agents of this Department are respectfully submitted, with the recommendation that they be published as Bulletin No. 31 of this Office.

Respectfully,

A. C. TRUE,

Director.

Hon. J. Sterling Morton,
Secretary of Agriculture.



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INVESTIGATIONS CONCERNING FOOD SUPPLY AND CONSUMPTION IN MISSOURI IN 1895.

This investigation has been prosecuted in two directions, namely, (1) an inquiry regarding the bread and meat consumption in the State, and (2) the studies of two dietaries of a students' boarding club at the State university.

PLAN OF INVESTIGATIONS.

The methods followed in the two dietaries described in this report are essentially those explained by Professor Atwater in a previous publication of this Office.¹ The waste, however, was treated in a different way, which is described in detail. The methods used in analysis are those described in the report of the Connecticut Storrs Station for 1891, pp. 47–49, and in Bulletin No. 29 of this Office, p. 8.

BREAD AND MEAT CONSUMPTION.

The university community furnishes an excellent field for the collection of approximate statistics regarding the dietary practices which prevail throughout the State. The students represent almost every county in the State, and are drawn from families in all the ordinary walks of life. Information furnished by them as to the kinds and approximate quantities of bread and meat used in their homes, while doubtless not accurate in comparison with, for instance, the statistical results of the study of a dietary, compares favorably with the quality of the average statistical information. With a view to the collection of information of this character, a circular, of which the following list of questions formed the essential feature, was placed in the hands of the students of the university:

GENERAL STATISTICS.

Home residence.—Town, ——. County, ——.

Occupation.—Please underscore the occupation of the head of your family: Farmer. Mechanic. Business. Professional.

Family.—Number of persons over 18 years, ——. Number of persons 12 to 18 years, ——.

SPECIAL STATISTICS.

Bread.—Please state the approximate percentages of the following kinds of bread used in your home: Biscuit, —— per cent; light bread, —— per cent; corn bread, —— per cent.

Meat.—Please state the approximate percentages of the following kinds of meat used in your home: Beef, — per cent; veal, — per cent; pork, — per cent; mutton, — per cent; poultry, — per cent; game, — per cent; fish, — per cent.

Two hundred and eighty-two replies, representing as many families, living in 74 of the 114 counties of the State, were received. These statistics are given in a condensed form in Table 1. The proportions of the various kinds of bread and meat used at the college boarding club are also included in the table, the quantities of biscuit and corn bread being estimated from the amounts of flour and corn meal which were consumed during the dietary tests. All the raised bread used at the club was purchased at a local bakery.

The figures in the table express percentages and not amounts. Those for bread show the percentage which each kind is estimated to make of the total bread used. The same is true with the meat. That is to say, when the reports from the farmers' families were classified and their statements averaged, it appeared that in 142 families, living in 59 counties, the average number of persons per family was 6.4. Of every 100 pounds of "bread" used by these families 53.7 pounds were in the form of biscuit, 30.7 pounds were raised bread, and 15.6 pounds corn bread. Of the total weight of meat 56.9 per cent was pork, 20.9 beef, and 12.9 poultry, the remainder consisting of mutton, veal, fish, and game.

Table 1.—Approximate bread and meat consumption of families in Missouri.

	Fam	ilies.	ed.	Kind	ls of b	read.	Kinds of meat.						
Occupation.	Total number.	Average number of persons.	Counties represented.	Biseuit.	Raised bread.	Corn bread.	Boef.	Veal.	Pork.	Mutton.	Poultry.	Game.	Fish.
Mechanics	14 77 48	5. 1 5. 4 5. 4	6 31 28	P. ct. 46. 7 44. 9 52. 6	P. ct. 41. 4 41. 8 36. 2	P. ct. 11. 9 13. 3 11. 2	P. ct. 40. 2 49. 6 47. 0	P. ct. 2. 9 4. 0 3. 3	P. ct. 32. 4 23. 5 25. 3	P. ct. 3. 6 2. 7 4. 5	P. ct. 11. 0 12. 0 11. 7	P. ct. 2. 8 2. 8 3. 1	P. ct. 7. 1 5. 4 5. 1
Average Farmers University boarding club	142	6. 4	59	48. 1 53. 7 45. 0	39. 8 30. 7 46. 0	12. 1 15. 6 9. 0	45. 6 20. 9 66. 0	3.4	27. 0 56. 9 26. 0	3.6 2.7	11. 6 12. 9 6. 0	2.9 2.9	5. 9 2. 8 2. 0

The contrast between the food consumption of the farmers' families (country population) and those of mechanics, business and professional men (largely town population) is well defined, and in some respects even striking. Especially is this true of the meats consumed. The farmer does not have easy access to the butcher's shops, and furthermore has no conveniences for keeping fresh beef. He therefore lives largely on pork and poultry, the former being more palatable when preserved than when fresh, and the latter always at hand.

THE DIETARY STUDIES.

The university boarding club is specially adapted to a dietary study. This club, which has a membership of approximately 100, is conducted in essentially the same manner as the numerous boarding clubs which form such a prominent feature of American college communities. Its members, with few if any exceptions, are Missourians, coming from families engaged in the ordinary vocations and living in all portions of the State. These young men live in a thoroughly substantial although modest fashion, their table being, in so far as practicable, copied after the dietary practices of their own homes. The extent to which they succeed in this may be seen from Table 1. The percentages of biscuit, raised bread, and corn bread do not differ essentially from those prevalent in the State at large; that of the beef is noticeably higher. This is due largely to two causes, namely, an opportunity for the storage of fresh meat, which is of course wanting in rural communities, and perhaps more especially to the fact that the club buys its beef by the quarter during a considerable portion of the year.

The details of the dietaries will be found beyond (Tables 6, 7, 8, 9, 10, and 11). The preliminary test (No. 94)¹ covered a period of six consecutive days, and the final test (No. 95) a period of seven consecutive days. The amount of nutrients purchased, wasted, and eaten per man per day in each test and the average of the two are shown in the following table:

Table 2.—Nutrients purchased, wasted, and eaten per man per day.

	Protein.	Fat.	Carbohy-drates.	Fuel value.	Nutritive ratio.
Purchased:	Grams.	Grams.	Grams.	Calories.	
No. 94	107	169	458	3,885	
No. 95	107	183	443	3, 960	
Average	107	176	450	3,920	
Vasted:				-,	
No. 94	11	14	41	350	l
No. 95	îî	18	39		
Average	îî	16	40	360	
Caten:	11	10	30	000	
No. 94	96	155	417	3, 540	1:8.0
No. 95	96	165	404	3,585	1:8.0
Average	96	160	410	3, 560	1:8.0

These dietaries are striking in point of their comparatively high potential energy and wide nutritive ratio, due to the relatively large proportions of fats and carbohydrates. The protein consumed (95 grams) is slightly below the average, and furthermore 40 per cent of the protein is of vegetable origin, principally from bread. Inasmuch as the digestibility of the vegetable protein is slightly less than that of the animal protein, the actual metabolism of the nitrogen compounds could hardly have exceeded 90 grams. This possible shortage seems

¹The numbers of the dietary studies are laboratory numbers used in the investigations of which this study forms a part.

to have been covered by an increased consumption of fats, the average amount being 161 grams. This substitution can, however, scarcely be regarded as detrimental, as it does not entail an undesirable excess of the carbohydrates, which is usually the most noticeable defect in dietaries with so wide a nutritive ratio.

The protein compounds form 14.4 per cent of the weight of the total nutrients, and their energy amounts to 11 per cent of the total energy.

The method employed in handling the table and kitchen wastes deserves special attention. The wastes were kept in three distinct portions, namely, (1) meats and other animal food materials; (2) bread of all descriptions, and (3) vegetables. No attempt was made to dry this material, but at intervals of a few days, the interval depending on the rapidity of the accumulation and the weather, each portion was treated as follows:

- 1. Meat, etc.—All bone was removed and the edible portion was chopped, weighed, and sampled. This sample was then prepared for analysis in the ordinary manner.
- 2. Bread.—The various kinds of bread were separated, weighed, sampled, and analyzed in the usual way.
- 3. Vegetables.—This portion of the waste was thoroughly mixed, weighed, and sampled and the sample prepared for analysis in the same way as the meats. Each sample of meat and vegetable waste was analyzed separately, although "composite samples" might have been made.

This method has two decided advantages—first, a great saving of labor and fuel, and second, the possibility of an actual division of the nutrients according to their respective sources, namely, animal foods, bread and breadstuffs, and vegetables.

DESCRIPTION OF FOOD MATERIALS ANALYZED.

In connection with the dietary studies the following analyses were made:

Beef.—The local market was considerably affected by the unusually high prices which prevailed at the time when these dietary studies were made (May, 1895). Much of the beef offered for sale had been raised in the immediate vicinity, and at that season was very young, watery, and often immature as well; high prices elsewhere had forced it upon the market before it was in the proper condition.

With the exception of the samples of porterhouse steak (86) and rib ends (172), the analyses will be of little interest except in their present use. The beef used at the boarding club at a given meal was of such a varied character—often representing four or five cuts—that it was impossible with the time at our disposal to take specimens of each particular cut for analysis. Specimens 120-123, 124 and 125 are therefore samples of miscellaneous cuts of the forequarter—rib.chuck, neck,

brisket, plate, etc., in whatever proportion the several cuts were purchased in the market for each meal.

Pork.—No. 2088 was a so-called "country-cured" shoulder. Farmers salt shoulders and hams for winter and spring use, but do not smoke them. Pork cured in this way is used largely in the country, and a considerable quantity of it finds its way into town groceries.

Poultry.—No. 2706 was a fowl of average fatness.

Dairy products.—Nos. 11, 12, and 13 are milk from a Holstein-Friesian herd and No. 14 is from a Jersey herd. No. 15 is a fair specimen of farmer's butter. Nos. 4030 and 4041 are "cottolene" and "oleomargarine," respectively.

Bread, etc.—No. 5430 is wheat bread, baker's 5-cent loaf. No. 5438 is graham bread, baker's 5-cent loaf. No. 5450 is soda and sour milk or baking powder biscuit, homemade. This is the form of wheat bread principally used in country districts, and also to a considerable extent by town population. (See Table 1.) No. 5150 is wheat flour, so-called "half patent," milled in Columbia. No. 6107 is sorghum molasses.

Table 3.—Composition of food materials as purchased, including both edible portion and refuse, analyzed at Columbia, Mo.

Kind of food material.	Reference num- ber.	Refuse.	Water.	Pro- tein.	Fat.	Carbohy- drates.	Ash.	Fuel value per pound.
ANIMAL FOOD. Beef: Porterhouse steak	866 1722 124 125 120 121 122 123 4030 4041 2088 2706 215 211 212 213 214	Per ct. 14.5 21.0 25.5 15.0 13.5 13.5 12.5 10.5	Per ct. 49, 1 42, 6 30, 5 45, 3 53, 2 64, 4 52, 8 52, 0 10, 2 16, 7 44, 7 12, 5 88, 7 91, 3 91, 7 91, 3	Per ct. 16.9 14.2 12.0 14.1 17.1 17.3 16.8 16.9 11.0 10.7 12.8 11.2 3.5 3.5	Per ct. 18. 6 21. 4 25. 3 24. 8 15. 2 3. 7 17. 0 19. 6 100. 0 86. 1 43. 1 8. 8 84. 7 3. 7 . 7 1. 1	3.4 3.8	0.9	Calories. 1, 100 1, 105 1, 290 1, 3, 101 960 480 1, 033 1, 140 4, 222 3, 650 2, 020 610 3, 5303 285 160
Wheat flour, roller process Bread	5150 5430 5438 5450 6107		11. 1 31. 4 30. 5 22. 9 27. 4	11. 7 7. 3 7. 4 9. 3	. 8 . 7 2. 3 13. 7	75. 9 59. 5 58. 4 52. 6 69. 5	. 5 1. 1 1. 4 1. 5 3. 1	1, 665 1, 270 1, 320 1, 730 1, 290

¹ Curd.

² Columbia laboratory number.

³ Only water and fat determined.

Table 4.—Composition of fresh, edible portion of food materials analyzed at Columbia, Mo.

Kind of food material.	Reference number.	Water.	Protein.	Fat.	Carbohy- drates.	Ash.	Fuel value per pound.
ANIMAL FOOD. Beef: Porterhouse steak Rib Roast Do Steak forequarter Do Do Cottolene Oleomargarine Pork: Shoulder, salted (not snoked). Poultry: Fowl. Butter Milk, whole Milk, skimmed Milk, skimmed, sour³. Buttermilk³.	123 4030 4041 2088 2706 215 211 212	Per cent. 57. 4 53. 9 49. 0 53. 3 61. 5 74. 4 44. 58. 1 10. 2 22. 6 66. 7 12. 5 88. 7 91. 3 91. 7 91. 3	Per cent. 19. 8 18. 0 16. 1 16. 6 19. 8 20. 0 19. 2 18. 9 11. 0 14. 5 19. 1 11. 2 3. 5 3. 5	Per cent. 21.8 27.1 34.0 29.2 17.6 4.3 19.4 21.9 100.0 86.1 58.2 13.1 84.7 3.7 .6 .7 1.1	Per cent.	Per cent. 1. 0 1. 0 9 9 1. 1 1. 3 1. 0 1. 1 2. 7 4. 7 1. 1 1. 6 7 8	Calories. 1, 290 1, 480 1, 735 1, 540 1, 110 555 1, 175 1, 275 4, 220 3, 650 2, 725 905 3, 595 285 160
Wheat flour, roller process Bread Bread, graham Biscuit Molasses (sorghum)	5430 5438 5450	11. 1 31. 4 30. 5 22. 9 27. 4	11.7 7.3 7.4 9.3	.8 .7 2.3 13.7	75. 9 59. 5 58 4 52. 6 69. 5	.5 1.1 1.4 1.5 3.1	1, 665 1, 270 1, 320 1, 730 1, 290

¹ Curd.

Table 5.—Composition of water-free substance of edible portion of food materials analyzed at Columbia, Mo.

Kind of food material.	Reference number.	Nitro- gen.	Protein.	Fat.	Carbohy-drates.	Ash.
ANIMAL FOOD. Beef: Porterhouse steak Rib Roast Do. Steak, forequarter Do. Do. Do. Cottolene Oleomargarine Pork: Shoulder, salted (not smoked) Butter Milk, whole Milk, skimmed Milk, skimmed, sour ³ Buttermilk ³	2706 215 211 212	Per cent. 7.36 6.43 5.16 5.69 8.17 12.58 7.64 7.31	46. 5 39. 0 31. 6 35. 6 51. 4 78. 1 48. 5 45. 1 11. 1 18. 7 57. 4 11. 4 31. 0	51. 2 58. 8 66. 7 62. 5 45. 7 16. 8 49. 0 52. 3 100. 0 95. 9 75. 2 39. 3 96. 8 32. 7 6. 9 8. 4	Per cent.	2.3 2.2 1.7 1.9 2.9 5.1 2.5 2.6 3.0 6.1 3.3 1.8 6.2 9.2
Wheat flour, roller process	5430 5438 5450		13. 2 10. 6 10. 7 12. 1	1.0 3.3 17.8	85. 4 86. 8 84. 0 68. 2 95. 7	1.6 2.0 1.9 4.3

¹ Curd.

² Columbia laboratory number.

³ Only water and fat determined.

²Columbia laboratory number.

³Only water and fat determined.

DIETARY STUDIES OF THE COLLEGE CLUB IN MISSOURI.

FIRST DIETARY STUDY OF THE COLLEGE CLUB (No. 94).

The study began May 10, 1895, and continued six days.

The club was composed of 98 male students, the matron, and the household servants.

The number of meals taken was as follows:

Men	00
Women (124 meals × 0.8 meal of man) equivalent to	99
Children (20 meals × 0.7 meal of man) equivalent to	14

Remarks.—With exception of the waste no analyses were made especially for this test. When possible the estimates of composition were based upon analyses made for the final test; in other cases the averages of American analyses* were taken.

Table 6.—Composition and amounts of food materials and table and kitchen wastes in dietary of the college club in Missouri (dietary No. 94).

	Percen	tage comp	osition.	•	Weigh	t used.	
Kind of food material.				Total		Nutrients	
	Protein. Fat.		Carbohy- drates.	food mate- rial.	Protein.	Fat.	Carbohy-drates.
ANIMAL FOOD. Beef: Steak¹. Do Roast¹. Oleomargarine¹	Per cent. 17.1 17.0 13.4 1.0	Per cent. 15. 2 13. 4 23. 8 86. 1	Per cent.	Grams. 16, 560 8, 620 52, 050 16, 010	Grams. 2. 832 1, 465 6, 975 160	Grams. 2, 517 1, 155 12, 388 13, 784	Grams.
Total				93, 240	11, 432	29, 844	
Pork, etc.:	14.1 10.7 10.7	25. 6 43. 1 43. 1 100. 0		9, 980 5, 690 35, 150 29, 260	1, 407 609 3, 761	2, 555 2, 452 15, 150 29, 260	
Total Poultry: Fowl ¹ Fish, salmon, canned Eggs Butter ¹ Cheese Milk, whole ¹ Milk, skimmed ¹ Butternilk ¹	12.8 20.7 13.1 1.2 26.0 3.5 3.5 3.3 3.3	8.8 10.8 9.5 84.7 34.2 3.7 .6 .7	2.3 3.4 3.8 3.6 3.5	80, 080 790 7, 150 32, 430 13, 720 910 102, 060 222, 720 12, 250 52, 620	5, 777 101 1, 480 4, 248 165 237 3, 572 7, 795 404 1, 736	49, 417 70 772 3, 081 11, 621 311 3, 776 1, 336 1, 366 579	21 3, 470 8, 463 441 1, 842
Total animal food				617, 970	36, 947	100, 893	14, 323
VEGETABLE FOOD. Cereals, sugar, etc.: Cornmeal. Flour, wheat ¹ Oatmeal. Biscuit, soda ¹ Bread, graham ¹ Bread, white ¹ Crackers, cream Macaroni Sugar, granulated Molasses, sorghum ¹ Cocoa	8. 9 11. 7 15. 6 9. 3 7. 4 7. 3 9. 3 11. 7	2. 2 .8 7. 3 13. 7 2. 3 . 7 13. 1 1. 6	75. 1 75. 9 68. 0 52. 6 58. 4 59. 5 69. 2 72. 9 100. 0 69. 5 37. 7	17, 060 100, 930 3, 520 2, 610 39, 850 87, 540 4, 760 2, 490 45, 340 30, 730 230	1, 518 11, 811 549 243 2, 912 6, 390 443 291	375 807 257 358 905 613 623 40	12, 812 76, 605 2, 394 1, 373 22, 986 3, 294 1, 815 45, 340 21, 357 87

¹ Composition estimated from analyses made in the subsequent dietary.

^{*} U. S. Dept. Agr., Office of Experiment Stations Bul. 28.

Table 6.—Composition and amounts of food materials and table and kitchen wastes in dietary of the college club in Missouri (dietary No. 94)—Continued.

	Percen	tage comp	osition.		Weigh	t used.	
Kind of food material.			Carbohy-	Total food		Nutrients	
	Protein.	Fat.	Fat. drates.		Protein.	Fat.	Carbohy-drates.
VEGETABLE FOOD-cont'd.							
Vegetables: Beans, dried. Beans, string. Corn, canned Letture Potatoes (35.5 per cent refuse) Rhubarb Spinach	Per cent. 22.3 2.2 2.8 1.1 2.1 4.4 2.1	Per cent. 1.8 .4 1.3 .3 .1 .4 .5	Per cent. 59. 1 9. 4 19. 3 2. 7 18. 0 2. 2 3. 1	Grams. 10, 090 3, 860 5, 900 5, 670 101, 380 7, 820 7, 480	Grams. 2, 250 85 165 62 2, 129 32 157	Grams. 181 15 77 17 101 31 37	Grams, 5, 964 363 1, 139 153 18, 249 172 232
Tomatoes, canned	1. 2	.2	4. 0	25, 170	302	50	1,007
Total				167, 370	5, 182	509	27, 279
Fruit, nuts. etc. : Apples Nectarines Strawberries	. 4 . 6 1. 0	. 4	12. 4 14. 8 6. 8	11, 340 8, 850 9, 870	46 53 99	45 69	1, 406 1, 310 671
Total				30,060	198	114	3, 387
Total vegetable food				531, 990	29, 587	4,667	270, 809
Total food				1. 149, 960	66, 534	105, 560	285, 132
Table and kitchen waste: Meat. Do Fat.	22. 1 25. 2	39. 1 32. 3 100. 0		6, 120 7, 820 2, 150	1, 353 1, 971	2, 393 2, 526 2, 150	
Total animal				16,090	3, 324	7,069	
Bread Vegetable Do	7.3 6.8 4.3	1, 2 12, 8 5, 3	59. 1 43. 6 16. 7	33, 680 8, 730 10, 660	2, 459 594 458	404 1,117 565	19, 905 3, 806 1, 780
Total vegetable				53, 070	3, 511	2,086	25, 491
Total waste				69, 160	6, 835	9, 155	25, 491

Table 7.—Recapitulation of weights and percentages of food materials and nutritive ingredients used in dietary of the college club in Missouri (dietary No. 94).

		Weight:	in grams	١.	1	Veight	in pour	nds.
Kind of food material.		Food		Nutrients.				
	Food material.	Pro- tein.	Fat.	Carbohy-drates.	ma- terial.	Pro- tein.	Fat.	Carbohy- drates.
FOR FAMILY, 6 DAYS.								
Beef, veal, and mutton. Pork, lard, etc. Poultry Fish, etc. Eggs Butter Cheese. Milk	93, 240 80, 080 790 7, 150 32, 430 13, 720 910 389, 650	11, 432 5, 777 101 1, 480 4, 248 165 237 13, 507	29, 844 49, 417 70 772 3, 081 11, 621 311 5, 777	86 21 14, 216	205. 6 176. 5 1. 7 15. 8 71. 5 30. 2 2. 0 858. 9	25. 2 12. 7 . 2 3. 3 9. 4 . 4 . 5 29. 8	65. 8 108. 9 . 2 1. 7 6. 8 25. 6 . 7 12. 7	0. 20
Total animal food	617, 970	36, 947	100, 893	14, 323	1, 362. 2	81.5	222. 4	31.60
Cereals, sµgars, starches Vegetables Fruits	334, 560 167, 370 30, 060	24, 207 5, 182 198	4, 044 509 114	240, 143 27, 279 3, 387	737. 6 369. 0 66. 2	53. 4 11. 4 . 4	8. 9 1. 1 . 3	529. 40 60. 20 7. 50
Total vegetable food	531, 990	29, 587	4,667	270, 809	1, 172. 8	65.4	10.3	597. 10
Total food	1, 149, 960	66, 534	105, 560	285, 132	2, 535. 0	146.7	232. 7	628.70

Table 7.—Recapitulation of weights and percentages of food materials and nutritive ingredients used in dietary of the college club in Missouri (dietary No. 94)—Cont'd.

	,	Weight i	n grams		V	Veight	in poun	ds.
Kind of food material.	Food		Nutrient	8.	Food		Nutrie	its.
	material.	Pro- tein.	Fat.	Carbohy- drates.	ma- terial.	Pro- tein.	Fat.	Carbohy- drates.
PER MAN PER DAY.								
Beef, veal, and mutton Pork, lard, etc	150 129 1	18 9	48 79		0, 33 , 29	0. 04 . 02	0.11	
Fish, ctc. Eggs. Butter.	12 52 22	2 7	1 5 19		. 03 . 11 . 05	. 02	.01	
Cheese	627	22	9	23	1.38	. 05	. 02	0.05
Total animal food	994	59	162	23	2.19	. 13	. 36	. 05
Cereals, sngars, starches Vegetables Fruits	538 269 48	39	6 1	386 44 5	1. 19 . 59 . 11	.09	. 01	. 85 . 10 . 01
Total vegetable food	855	48	7	435	1.89	. 11	.01	. 96
Total food	1,849	107	169	458	4.08	. 24	. 37	1.01
PERCENTAGES OF TOTAL FOOD. Beef, veal, and mutton Pork, lard, etc Poultry Fish, etc Eggs Butter Cheese Milk	.1 .6 2.8	Per ct. 17.2 8.7 .1 2.2 6.4 .2 .4 20.3	Per et. 28.3 46.8 .1 .7 2.9 11.0 .3 5.5					
Total animal food	53.7	55.5	95, 6	5.0				
Cereals, sugars, starches Vegetables Fruits	29. 1 14. 6 2. 6	36. 4 7. 8 . 3	3. 8 . 5 . 1	84. 2 9. 6 1. 2				
Total vegetable food	46.3	44. 5	4.4	95. 0				
Total food	100.0	100, 0	100.0	100.0				

Table 8.—Nutricuts and potential energy in food purchased, rejected, and eaten in dietary of the college club in Missouri (dietary No. 94).

		Nutrients		771
Kind of food material.	Protein.	Fat.	Carbohy- drates.	Fuel value.
Food purchased: Animal Vegetable.	Grams. 36, 947 29, 587	<i>Grams</i> . 100, 893 4, 667	Grams. 14, 323 270, 809	Calories. 1, 148, 510 1, 275, 030
Total	66, 534	105, 560	285, 132	2, 423, 540
Waste: Animal Vegetable.	3. 324 3, 511	7, 069 2, 086	25, 491	79, 370 138, 310
Total	6, 835	9, 155	25. 491	217, 680
Food actually eaten: Animal Vegetable.	33, 623 26, 076	93, 824 2, 581	14, 323 245, 318	1, 069, 140 1, 136, 720
Total	59, 699	96, 405	259, 641	2, 205, 860

Table 8.—Nutrients and potential energy in food purchased, rejected, and caten in dietary of the college club in Missouri (dietary No. 94)—Continued.

	Nutrients.			Fnel
Kind of food material.	Protein.	Fat.	Carbohy- drates.	value.
PER MAN PER DAY.				
Food purchased:	Grams.	Grams.	Grams.	Calories.
Vegetable	59 48	162	23 435	1, 840 2, 045
Total	107	169	453	3, 885
Waste:				
Animal	5 6	11 3	41	125 220
Total	11	14	41	345
Food actually eaten:				
Animal ` Vegetable		151 4	23 394	1, 715 1, 825
Total	96	155	417	3, 540
PERCENTAGES OF TOTAL FOOD PURCHASED.				
Food purchased:		Per cent.	Per cent.	Per cent.
Animal Vegetable	55. 5 44. 5	95. 6 4. 4	5. 0 95. 0	47. 4 52. 6
Total	100.0	100.0	100.0	100.0
Waste:				
Animal Vegetable		6.7 2.0	8.9	3.3 5.7
Total	10.3	8. 7	8.9	9.0
Food actually eaten:				
Animal Vegetable	50. 5 39. 2	88. 9 2. 4	5. 0 86. 1	44. 1 46. 9
Total	89.7	91.3	91.1	91.0

SECOND DIETARY STUDY OF THE COLLEGE CLUB (No. 95).

The study began May 20, 1895, and continued seven days.

During this period the club was composed of 95 male students, the matron, and household servants.

The number of meals taken was as follows:	
	Meals.
Men	1,978
Women (156 meals × 0.8 meal of man) equivalent to	125
Children (40 meals × 0.7 meal of man) equivalent to	28
Total number of meals taken equivalent to	2, 131
Equivalent to one man seven hundred and ten days	

A considerable number of food materials were analyzed in this dietary, as was also the refuse. Such analyses are designated in the table following on page 17 by the letter a.

Table 9.—Composition and amounts of food materials and table and kitchen wastes in dietary of the college club in Missouri (dietary No. 95).

	Percen	tage con	position.		Weigh	t used.	
Kind of food material.			0 1 1	Total		Nutrients	
	Protein.	Fat.	Carbohy- drates.	food mate- rial.	Protein.	Fat.	Carbohy-drates.
Poof. ANIMAL FOOD.	Per ct.	Per ct.	Per cent.	Grams.	Grams.	Grams.	Grams.
Beef: Steak, forequarter (a)	17. 1	15. 2	1 er cent.	9,750	1,667	1,482	Grams.
Do	17.3 17.3	3. 7 3. 7		10, 660 5, 330	1, 844 922	394 197	
Steak, forequarter (a)	16.8	17.0		5, 440	914	925	
170	16. 9	19.6		10, 210	1.726	2,001	
Steak, porterhouse (a) Roast, miscellaneous (a)	16. 9 12. 0	18. 6 25. 3		9,750 10,770	1, 648 1, 292	1, 813 2, 725	
Do	14.1	24.8		9.980	1, 407	2, 475	
Roast, miscellaneous 1	13.1	25. 1 13. 4		16.560	2, 169	4, 157	
Rib ends (a)	17.0 14.2	21. 4		11, 340 3, 740	1, 928 531	1,520 800	
Rib ends (a). Dried and smoked Bologna Oleomargarine	31. 8	6.8	0.6	680	216	46	
Bologna	18. 0 1. 0	19.7 86.1		2,270 $14,630$	409 146	$\frac{447}{12,596}$	
Total				121, 110	16.819	31,578	4
Shoulders, salted (a)	10.7	43.1 100.0		19, 160 49, 220	2,050	8, 258 49, 220	
Total (a)				68, 380	2,050	57, 478	
Total (a)	12.8	8.8		16, 100	2,061	1,417	
Eggs	13. 1 1. 2	9.5 84.7		16, 100 41, 280 23, 250	5, 408 279	3,921	
Sutter (a) Cheese Ailk, whole (a) Ailk, skimmed (a)	26. 0	34. 2	2.3	8, 160	2, 121	19, 692 2, 791	18
Tilk, whole (a)	3, 5	34. 2	3. 4	8, 160 142, 770	4, 997	5, 283	4. 85
Milk, skimmed (a)	3. 5 3. 3	.6	3. 8 3. 6	274, 430 44, 430	9, 605 1, 466	1, 647 311	10, 428 1, 600
Suttermilk (a)	3. 3	1.1	3, 5	58, 970	1,946	649	2, 06-
Total animal food				798, 880	46, 752	124, 767	19, 138
VEGETABLE FOOD.							
Cereals, sugar, etc:							
Corn meal	8.9 11.7	2. 2	75. 1 75. 9	22, 230 99, 680	1, 978 11, 663	489 797	16, 693 75, 653
Oatmeal	15.6	. 8 7. 3	68. 0	4, 880	761	356	3, 31
Biscuit, soda (a)	9.3	13. 7	52. 6	680	63	93	358
Oatmeal Biscuit, soda (a) Bread, graham (a) Bread. wheat (a)	9. 3 7. 4 7. 3	2.3	58. 4 59. 5	45, 930 89, 360	3, 399 6, 523	1, 056 625	26, 82 53, 16
Crackers, cream Sugar, granulated Sugar, brown (a) Molasses, sorghum (a)	9. 3	13. 1	69. 2	89, 360 7, 140	664	935	4,94
Sugar, granulated			100. 0	36, 400			36. 400
Molasses, sorghum (a)			99. 2 69. 5	29, 140 25, 860			28, 90° 17, 97°
Cocoa	21.6	28. 9	37. 7	340	74	98	128
Total				361, 640	25, 125	4, 449	264, 369
Vegetables:	2. 2	4	0.1	4 000	110	20	460
Beans, string	2. 2	.4	9. 4 5. 8	4, 990 4, 310	91	17	469 250
Beans, string. Cabbage, edible portion. Corn, canned Lettuce Onions Peas, shelled Potatoes (31.5 per centrefuse). Radishes	2.8	1.3	19.3	25, 520	715	332	4, 92
Lettuce	1. 1 1. 5	.3	2.7 8.9	3, 180	35 29	9 7	8 17
Peas, shelled	4.4	.4	16. 1	1,930 2,270	100	ıi	36
Potatoes (31.5 per cent refuse).	2. 1	.1	18. 0	90, 150	1,893	90	16, 22
Rhubarh	1.0	.1	4. 6 2. 2	11, 000 17, 690	110 70	11 71	50 38
RhubarbSpinach	2. 1	, 5	3. 1	12, 470	262	62	383
Spinach		. 2	4.0	14, 180	170	29	567
Tomatoes, canned	1.2				3, 585	659	24, 34
Tomatoes, canned	1.2			187, 690	3, 363		21,01
Tomatoes, canned Total Fruits, nuts, etc.:			22. 9		16		
Tomatoes, canned Total Fruits, nuts, etc.: Bananas, pulp Jelly	1.2	.8	22. 9 77. 1	1, 360 4, 540	16 50	11	315
Tomatoes, canned Total Pruits, nuts, etc.: Bananas, pulp Jelly Pears	1. 2 1. 1 . 5		77. 1 10. 6	1, 360 4, 540 16, 330	16 50 82	11 98	31: 3,500 1,73:
Tonatoes, canned Total. Fruits, nuts, etc.: Bananas, pulp Jelly Pears Strawberries	1.2	.8	77.1	1, 360 4, 540 16, 330 16, 330	16 50 82 163	11 98 114	315 3, 500 1, 735 1, 111
Tomatoes, canned Total. Pruits, nuts, etc.: Bananas, pulp Jelly Pears Strawberries Total.	1. 2 1. 1 . 5 1. 0		77. 1 10. 6	1, 360 4, 540 16, 330 16, 330 38, 560	16 50 82 163 311	11 98 114 223	312 3,500 1,732 1,111 6,658
Tonatoes, canned Total. Fruits, nuts, etc.: Bananas, pulp Jelly Pears Strawberries	1. 2 1. 1 . 5		77. 1 10. 6	1, 360 4, 540 16, 330 16, 330	16 50 82 163	11 98 114	312 3,500 1,732 1,111 6,655 295,368 314,506

¹ Estimated from other analyses.

Table 9.—Composition and amounts of food materials and table and kitchen wastes in dietary of the college club in Missouri (dietary No. 95)—Continued.

	Percen	tage con	aposition. Weight used			t used.	d.	
Kind of food material.				Total	Nutrients.			
	Protein. Fat. Carbohydrates.	food ma- terial.	Protein.	Fat.	Carbohy drates.			
VEGETABLE FOOD—continued.								
Table and kitchen waste: Meat (a) Do Do Fat	23. 4 22. 1	Per ct. 23.7 37.7 35.0 100.0	Per cent.	Grams. 6, 350 6, 350 6, 010 4, 540	Grams. 1, 391 1, 486 1, 328	Grams. 1,505 2,394 2,103 4,540	Grams.	
Total animal				23, 250	4, 205	10, 542		
Bread, wheat (a). Bread, graham (a). Bisenit, søda (a). Vegetable (a). Do. Do.	7. 4 9. 3 2. 7 3. 0	. 7 2. 3 13. 7 2. 9 3. 6 5. 0	59. 5 58. 4 52. 6 13. 6 15. 3 12. 5	26, 650 6, 920 8, 960 5, 780 5, 780 9, 070	1, 945 512 833 156 173 254	187 159 1, 228 168 208 454	15, 85 4, 04 4, 715 786 88- 1, 13-	
Total vegetable				63, 160	3, 873	2, 404	27, 41	
Total waste				86, 410	8,078	12, 946	27, 41	

Table 10.—Recapitulation of weights and percentages of food materials and nutritive ingredients used in dietary of the college club in Missouri (dietary No. 95).

		Weight	in grams		Weight in pounds.				
Kind of food material.	72. 1		Nutrien	ts.	Food		Nutrien	ts.	
	Food material.	Pro- tein.	Fat.	Carbohy- drates.	ma- terial.	Pro- tein.	Fat.	Carbohy- drates.	
FOR FAMILY, 7 DAYS.									
Beef, veal, and mutton Pork, lard, etc Poultry Eggs	68, 380	16, 819 2, 050 2, 061 5, 408	31, 578 57, 478 1, 417 3, 921	4	266. 9 150. 7 35. 5 91. 0	37. 1 4. 5 4. 6 11. 9	69, 6 126, 7 3, 1 8, 7		
Butter Cheese Milk	23, 250 8, 160 520, 600	279 2, 121 18, 014	19, 692 2, 791 7, 890	188 18, 946	51. 3 18. 0 1, 147. 7	. 6 4. 7 39. 7	43. 4 6. 2 17. 4	0. 40 41. 80	
Total animal food	798, 880	46, 752	124, 767	19, 138	1, 761. 1	103. 1	275.1	42. 20	
Cereals, sugars, starches Vegetables Fruits		25, 125 3, 585 311	4. 449 659 223	264, 369 24, 344 6, 655	797. 3 413. 8 85. 0	55. 4 7. 9 . 7	9. 8 1. 4 . 5	582. 80 53. 60 14. 70	
Total vegetable food	587, 890	29, 021	5, 331	295, 368	1, 296. 1	64. 0	11.7	651.10	
Total food	1, 386, 770	75, 773	130, 098	314, 506	3, 057. 2	167.1	286. 8	693. 30	
PER MAN PER DAY.									
Beef, veal, and mutton	96	24 3 3 8	45 81 2 5 28 4		. 37 . 21 . 05 . 13 . 07 . 03	. 05 . 01 . 01 . 02	.10 .18 .01 .01 .06		
Milk	733	25	11	27	1. 62	.05	.02	. 06	
Total animal food	1, 125	66	176	27	2.48	. 15	. 39	. 06	
Cereals, sugars, starches Vegetables Fruits	264	35 5 1	6 1	372 34 10	1. 12 . 58 . 12	. 08	. 01	. 82 . 08 . 02	
Total vegetable food	828	41	7	416	1. 82	. 09	. 01	. 92	
Total food	1, 953	107	183	443	4, 30	. 24	.40	. 98	

Table 10.—Recapitulation of weights and percentages of food materials and nutritive ingredients used in dietary of the college club in Missouri (dietary No. 95)—Cont'd.

			Weight in pounds.					
Kind of food material.	72 1	Nutrients. Food Nutrients					ts.	
	Food material.	Pro- tein.	Fat.	Carbohy- drates.	ma- terial.	Pro- tein.	Fat.	Carbohy-drates.
PERCENTAGES OF TOTAL FOOD. Beef, veal, and mutton Pork, lard, etc. Poultry Eggs. Butter Cheese. Milk	Per cent. 8.7 4.9 1.2 3.0 1.7 .6 37.5	Per ct. 22.2 2.7 2.7 7.1 .4 2.8 23.8	Per ct. 24.3 44.2 1.1 3.0 15.1 2.1 6.1	Per cent.				
Total animal food	57. 6	61.7	95. 9	6. 1				
Cereals, sugars, starches Vegetables Fruits	26. 1 13. 5 2. 8	33. 2 4. 7 . 4	3.4 .5 .2	84. 1 7. 7 2. 1				
Total vegetable food	42.4	38. 3	4.1	93. 9				
Total food	100.0	100.0	100.0	100.0				

Table 11.—Nutrients and potential energy in food purchased, rejected, and eaten in dietary of the college club in Missouri (dietary No. 95).

		Nutrients		
Kind of food material.	Protein.	Fat.	Carbohy-drates.	Fuel value.
Food purchased: Animal Vegetable.	Grams. 46, 752 29, 021	Grams. 124, 767 5, 331	Grams. 19, 138 295, 368	Culories. 1, 430, 480 1, 379, 570
Total	75, 773	130,098	314, 506	2,810,050
Waste: Animal Vegetable	4, 205 3, 873	10, 542 2, 404	27, 415	115, 280 150, 640
Total	8,078	12, 946	27, 415	265, 920
Food actually eaten: Animal Vegetable.	42, 547 25, 148	114, 225 2, 927	19, 138 267, 953	1, 315, 200 1, 228, 930
Total	67, 695	117, 152	287, 091	2, 544, 130
PER MAN PER DAY. Food purchased: Animal Vegetable. Total	66 41 107	176 7	27 416 443	2, 020 1, 940 3, 960
Waste: Animal Vegetable Total	6 5	15 3	39	165 210 375
Food actually eaten : Animal Vegetable.	60 36	161	27 377	1, 855 1, 730
Total	96	165	404	3, 585
PERCENTAGES OF TOTAL FOOD PURCHASED. Food purchased: Animal Vegetable.	Per cent. 61. 7 38. 3	Per cent. 95. 9 4. 1	Per cent. 6. 1 93. 9	Per cent. 50. 9 49. 1
Total	100, 0	100.0	100, 0	100. 0

Table 11.—Nutrients and potential energy in food purchased, rejected, and eaten in dietary of the college club in Missouri (dietary No. 95)—Continued.

Kind of food material.	Protein.	Fat.	Carbohy-drates.	Fuel value.
PERCENTAGES OF TOTAL FOOD PURCHASED—continued.				
Waste: - Animal	Per cent. 5. 6 5. 1	8.1	Per cent.	4.1
Total	10.7	9.9	8. 7	9, 5
Food actually eaten: Animal Vegetable.	56. 1 33. 2	87. 8 2. 3	6. 1 85. 2	46. 8 43. 7
Total	89.3	90.1	91.3	90.5

14.000

COMMENTS ON THE FOOD INVESTIGATIONS AT THE UNIVERSITY OF MISSOURI.

By W. O. ATWATER and CHAS. D. WOODS.

After Professor Gibson had presented the foregoing, as a preliminary report of the food investigations undertaken by himself and associates at the University of Missouri, and before he had opportunity to give it the final revision which had been contemplated, he was stricken with an illness which proved fatal. His greatly lamented death not only prevents the contemplated elaboration of the results already obtained, but interrupts for the time the inquiries into the food economy of the people of Missouri which had been so successfully begun at the university. Much that Professor Gibson hoped to say and do must therefore be left unsaid and undone until the work can be taken up by others. Meanwhile the writers, with whom Professor Gibson had been associated for a number of years before going to Missouri and who have been familiar with his work there, add here a few comments.

THE BREAD AND MEAT CONSUMPTION OF FAMILIES IN MISSOURI.

The method of inquiry and the results detailed on pages 7,8 are of no little interest. Of course, statistics obtained by this method are always incomplete, but with the limited time and funds at Professor Gibson's disposal it is not easy to see how better answers to the questions as to the kinds and the relative amounts of meats and bread used in the ordinary households could have been obtained, and the number of families represented in the report is so large as to give decided value to the average figures.

It is to be remembered that these statistics are from families of the classes whose sons were at the university. It would seem, therefore, that they could hardly be assumed to represent exactly the eating habits of the average people of either the country districts or the cities of Missouri.

It will be observed that the term "bread" includes (1) ordinary wheat bread raised by use of yeast and designated as "raised" bread; (2) "biscuit" made from wheat flour but not fermented, and (3) "corn bread" made from maize.

The figures of the last column of the table, "Other meats, etc.," include game and fish. The figures show the proportion which each kind makes of the total amount consumed, but give no indication of the absolute quantities per person or per family for a given time.

How largely the sources of supply regulate the character of the food consumption is illustrated by the following table, taken from the figures given on page 8:

Table 12.—Kinds of bread and meat eaten by families in country and city.

	Ki	nds of bre	ad.	Kinds of meat.		
	Raised.	Biscuit.	Corn.	Beef, veal, mutton.	Pork.	Other meats, etc.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Farmers living in country, with limited access to markets.	31	54	16	24	57	19
Families living in cities or larger towns, with better markets	40	48	12	53	27	20

Evidently there is relatively much less of raised bread and more of corn bread and biscuit eaten in the country than in the town. It would seem natural to assume that the larger proportion of yeast-raised bread in the cities is due to bakers, to the ease with which good quick-acting yeast can be obtained, and to the fact that city people have more convenient markets to buy in and more ready money. The effect of supply upon the kinds of meat eaten is even more evident. Pork is easily raised on the farm, and in the form of salt pork, bacon, and ham is readily preserved for later use. On the other hand, city people can always have fresh beef, veal, and mutton from the markets. That this accounts largely for the fact that pork constitutes 57 per cent of the meat supply of the farmers' families and only 27 per cent of that of families living in the large towns is hardly to be doubted, though, of course, the relative cost may be a factor also. The fact that beef, veal, and mutton make more than half of the total meats eaten by well-to-do people in the cities and less than a quarter of that used by thrifty farmers is naturally explained in the same way.

COMPARISON OF DIETARIES OF COLLEGE STUDENTS IN MISSOURI, TENNESSEE AND CONNECTICUT.

It will be interesting to compare the results of the studies of the two dietaries of the students' club at the University of Missouri with those of investigations of other college clubs. The only other studies of this character made in the United States, and at present available and exactly comparable with these, so far as we are aware, are several series of dietary studies of students' clubs at Wesleyan University,¹ Middletown, Conn., and at the University of Tennessee,² Knoxville, Tenn.

¹Connecticut Storrs Station Reports, 1891-1894, and U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

²U. S. Dept. Agr., Office of Experiment Stations Bul. 29.

The students of the University of Missouri were mostly residents of that State, and it would seem fair to assume that their eating habits would be more or less such as they had acquired at home, although the diet in Columbia would be somewhat modified by the markets in that city at the time when the dietaries were made.

In the following table the results of the dietary studies at the three colleges are summarized. There is also appended to the table for comparison a suggested dietary standard for a man at light work. These comparisons are based upon the quantities of food actually eaten and not upon the total food purchased.

Table 13.—Comparison of nutrients in food caten by college clubs in Missouri, Tennessee, and Connecticut.

[Quantities	per	man	per	day.]

Kind of food material.	Protein.	Fats.	Carbohy- drates.	Fuel values.	Nutritive ratio.
FOOD EATEN. In Missouri: Animal	Grams. 57 39	Grams. 156 4	Grams. 25 385		
Total	96	160	410	3, 560	1:8.0
In Tennessee: Animal Vegetable	43 49	114 13	12 467		
Total	92	127	479	3, 520	1:8.3
In Connecticut: Animal Vegetable	63 36	131	21 315		
Total	99	139	336	3, 140	1: 6.7
Average of above: Animal Vegetable	53 42	131	19 400	1, 505 1, 915	
Total	95	140	419	3, 420	1: 7.8
Suggested standard for man with light muscular work (Atwater)	112			3,000	1: 5.5

We are far from urging that these results portray accurately the dietary practices of the people of the different sections represented by the young men in the three institutions. Still the families represented were doubtless numerous enough to represent fairly well the people of their classes and communities.

The case was similar with the club at Knoxville, whose members were nearly all from Tennessee. The homes of the students at Middletown were scattered through the northern Atlantic States, though a few were from other States and countries. The larger number were from towns with markets in which the available food materials were very similar to those in Middletown. The cost of board, like the general living expenses of the students at Middletown, was decidedly larger than that of the young men at Knoxville and Columbia.

¹U.S. Dept. Agr., Office of Experiment Stations Bul. 21.

It will be noticed that, as measured by the suggested standard, the food eaten in all three of the college clubs was deficient in protein and had an excess of the nutrients (fats and carbohydrates) which serve simply as fuel and tend to make the nutritive ratios wide. The standard represents nothing more than the attempt to state in a general way the proportions of nutrients which physiological experiment on the one hand and observations of the dietary habits of the best fed people on the other imply to be most appropriate. Among different dietaries here summarized the narrowest nutritive ratio is found in those representing the people who were most favorably situated with respect to both the kinds of food materials at their disposal and the pecuniary ability to select at will. The inference is that the diet of all, and especially of those in the more Southern States, would be improved by diminishing the carbohydrates and fats and increasing the protein.¹

See reference to the same subject in discussion of the dietaries of the students at the University of Tennessee, U.S. Dept. Agr., Office of Experiment Stations Bul. 29.



